Z-Weather

wind speed - humidity - temperature - barometric pressure -   
dew point - lightness - wind yield - solar yield



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# Quick Start

This QuickStart is intended for experienced users, who don‘t want to read the complete manual. It focusses on the core configuration parameters of Z-Weather and assumes detailed knowledge of Z-Wave systems. Skip to the “Introduction” chapter on page 4 if you are new to Z-Wave and would like to have a detailed introduction.

Before you can configure and use Z-Weather, the unit needs to be fully charged. In order to charge Z-Weather, place it in a location with direct sunlight exposure for 3-4 hours. Without direct sun light, charging may take 12 hours. To check if Z-Weather has been charged sufficiently, press the button located under the cup anemometer. If the LED blinks after pressing the button, Z-Weather is charged and operational.

## Button Functions

|  |  |
| --- | --- |
| **Function** | **Trigger Operation** |
| Battery Check | Push button once |
| Add/Remove | Push button 3x within 1.5 seconds |
| Wakeup | Push button 1x within 1.5 seconds |
| Factory Reset | Hold button for more than 2 seconds, then release |

## Z-Wave Parameters

Z-Weather will wake up depending on the available energy between every 5 minutes at noon in summer and every 5 hours in the second half of the night at winter solstice.

|  |  |
| --- | --- |
| **Parameter** | **Description** |
| Basic Get | Reads wind speed |
| Basic Set | No function |

## COMMAND\_CLASS\_CONFIGURATION

|  |  |
| --- | --- |
| **Parameter** | **Description** |
| Parameter 1 | Wind speed action threshold (same as Basic Set)  Value between 1 and 30 m/s  Default 6m/s  0 means off |
| Parameter 2 | Twilight action threshold  Value between 0 and 100%  Default value: 37% (street lightning) |

At threshold, a BASIC\_SET is send to the associated nodes of group 2-4. The basic set value can be changed using the ASSOCIATION\_COMMAND\_CONFIGURATION.

|  |  |  |
| --- | --- | --- |
| **Group** | **Description** | **Detail** |
| Group 1 | Lifeline | one node) |
| Group 2 | too much wind | up to 5 nodes, default BASIC\_SET 00 |
| Group 3 | getting bright | up to 5 nodes, default BASIC\_SET 00 |
| Group 4 | getting dark | up to 5 nodes, default BASIC\_SET FF |

## COMMAND\_CLASS\_ POWERLEVEL

|  |  |
| --- | --- |
| **Parameter** | **Constraint** |
| Timeout | << 30 seconds |
| Test frame count | << 1000 |

# Introduction

Z-Weather is a cup anemometer for Z-Wave installations. It continually measures the wind speed and can, for example, trigger closing of the awning and blinds if it is too windy. It also measures the amount of rotation, enabling calculation of the wind yield per day or per year. In addition, Z-Weather includes sensors for humidity, temperature, pressure and dew point, essentially providing the core sensors of a weather station.

Z-Weather is powered by a solar cell and stores energy on an internal capacitor, enabling continuous operation, even with no wind for a couple of days. It does not use any batteries and is completely maintenance free. Using the built-in solar cell it also measures the ambient light and the solar yield. This information can be used to turn on the outdoor light at dusk time and turn the light off in the morning.

Z-Weather‘s wind yield and solar yield metering can be used as a calculation base for planning a wind generator or a solar panel on the roof of a house.

Z-Weather can be included and operated in any Z-Wave network with Z-Wave certified devices from other manufacturers and/or other applications. All non-battery operated nodes within the Z-Wave network will act as repeaters regardless of vendor to increase reliability of the network and will enable Z-Weather to be contacted reliably even in larger installations.



Solar Cell

Push Button and LED

*Picture 1: Z-Weather and its operating elements*

During normal operation, Z-Weather is limiting continuous measurement to wind speed and solar radiation, other sensors are operating only on demand. This conservative energy management ensures continuous operation with the limited energy harvested from the solar cell powering Z-Weather. The Z-Wave radio frequency transmitter is turned off most of the time and is turned on if there is too much wind, at twilight time and on a continuous base, depending on the energy budget. The wake up interval is between five minutes at noon in summer and five hours in the second half of the night in winter. Z-Weather also wakes up on pushing the button.

# Startup

Before you can configure and use Z-Weather, the unit needs to be fully charged. In order to charge Z-Weather, place it in a location with direct sunlight exposure for 4-6 hours. Without direct sun light, the charging may take up to 12 hours. To check if Z-Weather has been charged sufficiently, press the button located under the cup anemometer. If the LED blinks after pressing the button, Z-Weather is charged and operational. Please refer to chapter “

Understanding the Internal Energy Management” on page 5 for more information.

# Operating Elements

All electronic components of Z-Weather are positioned inside the ball-bearing cup anemometer. At the bottom of the anemometer a button and a red LED is located. The LED lights up if the button was pressed and Z-Weather has enough energy to wake up and communicate wirelessly via Z-Wave. Using the button, the following commands can be performed:

## Button Commands

|  |  |  |
| --- | --- | --- |
| Push 1x | Wake-up | Push the button once within 1.5 seconds.  The LED blinks once indicating that Z-Weather is. Z-Weather sends a Z-Wave Wakeup-Notification if has been added to the network. If Z-Weather has not yet been added to the network, no action is performed. |
| Push 3x | Add to or remove from network | Push the button 3 times within 1.5 seconds.  The LED is blinking 3 times and the Network Information Frame (NIF) is sent to the Z-Wave network, adding Z-Weather to the network or removing it if it was previously added to the network. |
| Push and Hold | Reset to factory settings | Hold the button longer than 1.5 seconds and then release.  The LED blinks longer than when pressing the button once.  Z-Weather performs a factory reset and all configuration parameters are reset to their default values. |

If the LED is not blinking after releasing the button, Z-Weather has not enough energy and must be charged for several hours in bright sunlight.

# Place of Installation

Most of Z-Weather’s sensors are placed inside the top of the ball-bearing cup anemometer and they are measuring the environmental parameters inside the black round housing. If the sun is shining and Z-Weather is placed in direct sunlight, the housing will warm up and the temperature is higher than the temperature outside the housing. Thus a place in the shadow is the best choice for placing Z-Weather. Even though Z-Weather is powered by a solar cell, it is not required to place Z-Weather exposed to direct sun light and there is no need to face it south. The solar cell will produce sufficient energy to power Z-Weather, even if the solar cell is facing north and the device is in the shadow all day.

# Understanding the Internal Energy Management

Z-Weather is maintenance free and works environmentally friendly using solar power, it does not contain any batteries. The solar cell charges an internal capacitor, which buffers all harvested energy and powers the electronic components during the night.

When first operating Z-Weather after installation, it is required to fully charge the device by placing it in direct sunlight for 4-6 hours. Even though the capacitor is pre-charged at the factory, the capacitor has most likely lost most of its energy and does not provide sufficient power for operating Z-Weather immediately after unpacking. If the capacitor is completely empty it must be charged from 0% to 100% which takes longer than in subsequent charging cycles. Once Z-Weather is installed and operating, it is charged on a day by day base and the capacitor will never be discharged completely.

If the capacitor is completely discharged, which only can happen at time of delivery of if Z-Weather was stored at a dark place for weeks, charging may need up to 6 hours in direct sunlight during summer and up to 2 days during winter solstice and grey sky.

In order to check the functionality of Z-Weather and test whether the device has sufficient energy to operate, press the button located under the anemometer. If the LED blinks, Z-Weather has enough energy to operate.

It is good practice to perform the initial setup of Z-Weather at noon. After the first charging cycle is completed, the device will have stored enough energy for setup and adding the device to the Z-Wave network. However if you want to experiment with settings, or use the power consuming POWERLEVEL command class, Z-Weather may quickly use up all its energy reserve and may need to be charged again. If you configure Z-Weather at noon, the device had the entire morning for a full charge, has strong sun light when it uses the most energy (during configuration) and has the complete afternoon for recharging.

As a rule of thumb: After pressing the button eight times, Z-Weather will have used up the energy stored. When the energy has been used up, the LED does not blink and Z-Weather needs to be charged for approximately 1-2 hours.

# Adding and Removing from the Network (Inclusion/Exclusion)

Press the button 3 times within 1.5 seconds to add Z-Weather to the network. Z-Weather sends a NIF (Network Information Frame) and waits 4 seconds for inclusion to the Z-Wave network. If no controller includes Z-Weather, it goes to sleep after 4 seconds. Make sure to first instruct the inclusion controller to add a node and then press the Z-Weather button 3 times to add the device to the network.

# Default Function after Adding to the Network

Z-Weather wakes up regularly from time to time, if the button is pressed or unscheduled on the following events:

|  |  |
| --- | --- |
| Wind speed is higher than 6m/s (22km/h) | Association Group 2 |
| At the end of the dawn if it becomes bright | Association Group 3 |
| At the end of the dusk it getting dark | Association Group 4 |

After wakeup, Z-Weather first serves the associated groups. This is in all cases Group 1 “Lifeline” where it sends all readings to. In case of an unscheduled event, the associated groups 2-4 are also served. Finally it sends a wake up notification and goes to sleep if the controller does not require further communication.

# Supported Command Classes

Z-Weather supports the following Z-Wave command classes:

|  |  |
| --- | --- |
| COMMAND\_CLASS\_BASIC | Version 1 |
| COMMAND\_CLASS\_ZWAVEPLUS\_INFO | Version 2 |
| COMMAND\_CLASS\_MANUFACTURER\_SPECIFIC | Version 2 |
| COMMAND\_CLASS\_DEVICE\_RESET\_LOCALLY | Version 1 |
| COMMAND\_CLASS\_ASSOCIATION\_GRP\_INFO | Version 1 |
| COMMAND\_CLASS\_LANGUAGE | Version 1 |
| COMMAND\_CLASS\_ASSOCIATION | Version 2 |
| COMMAND\_CLASS\_MULTI\_CHANNEL\_ASSOCIATION | Version 2 |
| COMMAND\_CLASS\_POWERLEVEL | Version 1 |
| COMMAND\_CLASS\_VERSION | Version 2 |
| COMMAND\_CLASS\_BATTERY | Version 1 |
| COMMAND\_CLASS\_WAKE\_UP | Version 2 |
| COMMAND\_CLASS\_SENSOR\_MULTILEVEL | Version 6 |
| COMMAND\_CLASS\_METER | Version 3 |
| COMMAND\_CLASS\_MULTI\_CMD | Version 1 |
| COMMAND\_CLASS\_ASSOCIATION\_COMMAND\_CONFIGURATION | Version 1 |
| COMMAND\_CLASS\_CONFIGURATION | Version 1 |

# Functional Description of the Command Classes

Only the command classes with user interaction are described below. Z-Weather supports additional command classes, which are required for the Z-Wave-Protocol but are not described in the following enumeration, because the end user cannot interact with them.

## BASIC

|  |  |
| --- | --- |
| **Command Class** | **Description** |
| Basic Get | Reads the wind speed in m/s.  The reported wind speed is the maximum speed since the last wake up in meter per second. The unit can be converted to km/h by using the factor 3.6.  1m/s = 3,6km/h; 1km/h = 0,278m/s. |
| Basic Set | No function. |

## LANGUAGE

Sets the language for reporting the ASSOCIATION\_GRP\_INFO strings. Valid values:

|  |  |
| --- | --- |
| ger | German |
| eng | English |

The country information is not used and will be ignored.

## ASSOCIATION and MULTI\_CHANNEL\_ASSOCIATION

Z-Weather provides 3 groups supporting up to 5 nodes each, sending a single basic set command and one „Lifeline“-group supporting 1 node for reporting all measurements.

|  |  |
| --- | --- |
| Group 1 | Lifeline  All readings are sent on a regular schedule. The schedule time is set automatically between 5 minutes and 5 hours depending on the available energy. Lifeline is also served after the button was pushed or in case of an unscheduled wakeup (wind speed, twilight). Serves one group member. |
| Group 2 | Too windy  Sends: BASIC SET VALUE 0  Default action value: 6m/s (22km/h)  Serves up to 5 group members.  If the threshold value is exceeded, the basic set is sent to all group members. If the threshold value is exceeded for a long time, e.g. in case of storm for a couple of hours, the basic set value is sent repeatedly upon the scheduled wake up. Because in most cases the sun does not shine in case of storm, the repeated sending schedule may be between every one hour up to every five hours.  The default values can be changed:  ASSOCIATION\_COMMAND\_CONFIGURATION  Changes the BASIC SET VALUE between 0 and 255.  COMMAND\_CLASS\_CONFIGURATION  Parameter 1 changes the trigger threshold value between 0 (off) up to 30m/s. |
| Group 3 | It is getting bright    Sends: BASIC SET VALUE 0  Default value: 37% LUMINANCE (approx. street lightning)  Serves up to 5 group members.  ASSOCIATION\_COMMAND\_CONFIGURATION  Changes the BASIC SET VALUE between 0 and 255.  COMMAND\_CLASS\_CONFIGURATION  Parameter 2 changes the trigger threshold value between 0% (off) up to 100%. |
| Group 4 | It is getting dark  Sends: BASIC SET VALUE 255  Default value: 37% LUMINANCE (approx. street lightning)  Serves up to 5 group members.  ASSOCIATION\_COMMAND\_CONFIGURATION  Changes the BASIC SET VALUE between 0 and 255.  COMMAND\_CLASS\_CONFIGURATION  Parameter 2 changes the trigger threshold value between 0% (off) up to 100%. |

To suppress fast toggling between on and off at light fluctuation, Z-Weather uses a fixed pause interval of one hour between informing group 3 and group 4. In this hour the twilight phase is crossed.

## POWERLEVEL

Is used at installation time to rate the transmission reliability. By continuously sending short data packets and evaluating the answers, a reliability factor can be calculated. This can happen at different radio frequency power levels.

In extreme cases 65535 test data packets can be defined which results in 1.5 hours of continuously sending. The timeout for the power level can be set up to more than 4 minutes.

The well balanced energy budget of Z-Weather allows continuous sending of one minute if fully charged. This is more than ever used, except for the POWERLEVEL class.

This in mind, Z-Weather cannot send 1.5 hours continuously. It will turn off, if the energy level is below 5 %. This is identical to a timeout. Thus setting timeout greater than one minute is useless, because Z-Weather has no energy to be in sending state longer than a minute.

If not all data packets are sent when the energy is too low, Z-Weather memorizes the outstanding data packets and continues to send the remaining test data packets on next wakeup until all packets are sent. Depending on the sunshine, it can take more than a day until all 65535 data packets are sent and the transmission reliability can be calculated.

Thus it is strongly recommended to set the following parameters within the boundaries listed (even if Z-Weather is able to serve up to 65535 test frames):

|  |  |
| --- | --- |
| Timeout | << 30 seconds |
| Test frame count | << 1000 |

If test frame sending is active and Z-Weather needs to power down because of low energy level, it sends a battery status to lifeline as last action.

## BATTERY

Reports the energy level of the “Battery” between 0% and 100%. Z-Weather uses a capacitor instead of batteries, which is charged on a daily basis. Thus the “Battery”-Level fluctuates during the day between 100% in the afternoon and 10% early in the morning. Z-Weather has a build in energy management, which sets the wakeup interval depending on the energy level and turns off the push button if energy level is below 30%, so that there is enough energy for emergency situations to report wind and twilight.

## WAKE\_UP

Z-Weather has a built in energy manager which automatically calculates and sets the wakeup interval between 5 minutes (default) and 5 hours depending on the energy budget and the user setting. If the energy budget allows, the wakeup interval specified by the user determines the next wakeup time. However, if the energy manager calculates that the energy budget available is not sufficient to allow for the wakeup interval specified by the user, it will set a longer wakeup interval.

The energy manager aims to calculate the shortest possible wakeup interval to maximize the frequency of data reported to the network. The default wakeup interval of 5 minutes can be easily achieved with the energy harvested from sunlight at noon during summer. During winter, the automatically calculated wakeup interval may be extended to values between 1-2 hours. During early hours in the winter time, following a long night or if it was cloudy on the previous day, the automatically calculated wakeup time may be extended up to 5 hours.

For example, if the user specifies a wakeup interval of 10 minutes, the energy manager will not wakeup faster than every 10 minutes..

## SENSOR\_MULTILEVEL

Reports the following measurements:

|  |  |  |
| --- | --- | --- |
| **Measurement** | **Range** | **Accuracy** |
| Air temperature | -10.0°C to +60.0°C | ± 0.4°C |
| Luminance | 0 to 100% | ± 7% |
| Relative humidity | 1 to 100% | ± 3% |
| Wind speed | 0 to 31 m/s | ± 1m/s |
| Barometric pressure | 600 to 1200 mBar | ± 1mBar |
| Dew point | -56.4°C to +60.0°C | ± 0,7°C |

All readings are at the moment where they are sent, except the wind speed, which is the maximum wind speed since the last wake up time.

## METER

Reports the solar and the wind yield.

Z-Weather continuously samples the energy delivered by the solar cell. However, as the built in solar cell only delivers low levels of power (microwatts) and is very small, the measurement is normalized to a solar cell of 1 square meter and reported in kWh. This enables easier comparison of the yield per day or per month in reporting applications.

To calculate the wind yield, every eighth rotation is counted and the total sum reported as Pulse.

|  |  |
| --- | --- |
| **Parameter** | **Description** |
| kWh | Solar yield related to a solar cell with 1 square meter |
| Pulse | Total amount of rotations divided by 8 |

## COMMAND\_CLASS\_ASSOCIATION\_COMMAND\_CONFIGURATION

The association groups 2-4 send a basic set value to the associated nodes. The default value in case of too much wind is 0, which could be used to close the awning. In case of nightfall, the value will be 255, which could be used to trigger an action to turn on the light. The basic set values can be changed, to dim - for example - the light to only 20% instead of turning it on completely.

## CONFIGURATION

Sets the threshold for triggering wake up on wind or twilight.

|  |  |
| --- | --- |
| Parameter1 | Threshold for too much wind.  Crossing this parameter on the rising edge, Z-Weather sends a basic set to the associated groups, serves the lifeline and sends a wake up notification.    Default value: 6 m/s  Valid values: 0-30 m/s, where 0 means no notification on too much wind.  Values greater than 30 are interpreted as 30.  Size: 1 Byte  1m/s = 3,6km/h ; 1km/h = 0,28m/s |
| Parameter 2 | Threshold for twilight.  Crossing this parameter from night to day, association group 3 is informed. Crossing this parameter from day to night, association group 4 is informed.  Default value: 37% (approx. street lightning)  Valid values: 0-100%, where 0 means off.  Values greater than 100 are interpreted as 100.  Size: 1 Byte  The luminance 0-100% is related to the twilight. Note that 100% does not mean that the sun is shining. In the night, the luminance is 0%, increases with the dawn and is 100% at the end of the dawn. This might not be equal with sunrise and typically is some time before sunrise. In winter, on a cloudy day the luminance may be below 100%.  Internally, Z-Weather only distinguishes 7 steps of luminance. It is possible to set every value between 1-100%, but they are mapped internally to the fixed steps. |

# Technical Data

|  |  |
| --- | --- |
| Dimensions (length x width x height): | 33cm x 30cm x 11cm |
| Weight: | 300g |
| Protection marking: | IP 34 (IEC/EN 60529) |
| Additional protection: | Against bedewing |
| Control elements: | 1 push button, 1 LED |
| Maximum wind speed: | 160 km/h |
| Maintenance: | Maintenance free, no batteries to change |

|  |  |
| --- | --- |
| Z-Wave-Device-Type: | Non listening Routing Sensor Multilevel |
| Z-Wave-Plus Role Type: | Reporting sleeping slave |
| Z-Wave-Plus Node Type: | Multilevel Sensor |
| Z-Wave-Plus Icon Type: | Multidevice Multilevel Sensor |

|  |  |
| --- | --- |
| Z-Wave SDK: | 6.51 |
| Explorer Frames: | Yes |
| FLiRS: | No |

# Declaration of Conformity

Hereby Stagetronics declares that Z-Weather is in compliance with the essential requirements and other relevant provisions of the directives 2014/30/EU (EMC) and 2011/65/EU (RoHS).

For the evaluation of the compliance with these directives, the following standards are applied:

EN 50491, EN 55016, EN 55022, EN 61000, EN 301489, EN 300220

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Dortmund, 13.April 2015

# Additional documentation for the Z-Wave+ Certification

## INS11796-4 D.15.1 “Documentation about how to activate any functionality available in the device related to Z-Wave behavior”

There is a silver round programmers plug at the bottom of Z-Weather which is not part of the final product. Use the included cable for firmware update. The jumper J8 on the developer board must be closed to power Z-Wind with 3,3V during programming.

Z-Weather has limited energy. It may be more convenient to connect the Battery pack (includes 2xAA).

The shortest wake up interval is set if the solar cell is in bright light. For example: Using the Battery pack and putting the solar cell close to a neon lamp results in a wakeup interval of approximately 30-40 Minutes.

Or simply use the push button.

If Z-Weather is operating (e.g. staying alive 10 Seconds). The push button is not served.

## INS11796-4 D.15.2 “If any special procedures are REQUIRED to test any item in the certification form, such procedures MUST be clearly described”

Association Group 2 “too much wind”

The wind speed is sampled over a time of approx. 15 Seconds. To fire the association, rotate the top of Z-Weather with your fingers for a minimum of 15 seconds.

Association Groups 3+4 “getting bright / getting dark”

Store Z-Weather on a dark place or mask the solar cell completely to fire association group 4 “getting dark”. The cell must be really dark!

There is a minimum time of one hour between “getting bright / getting dark”. Thus hold the solar cell into the dark for at least one hour before putting the solar cell into the light. And vice versa.